



Mars Exploration Program

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4/7/18

Mars Exploration Program Science Goals



Life



Climate



Geology & Geophysics



Prepare for Human Exploration



Mars Exploration Program Missions

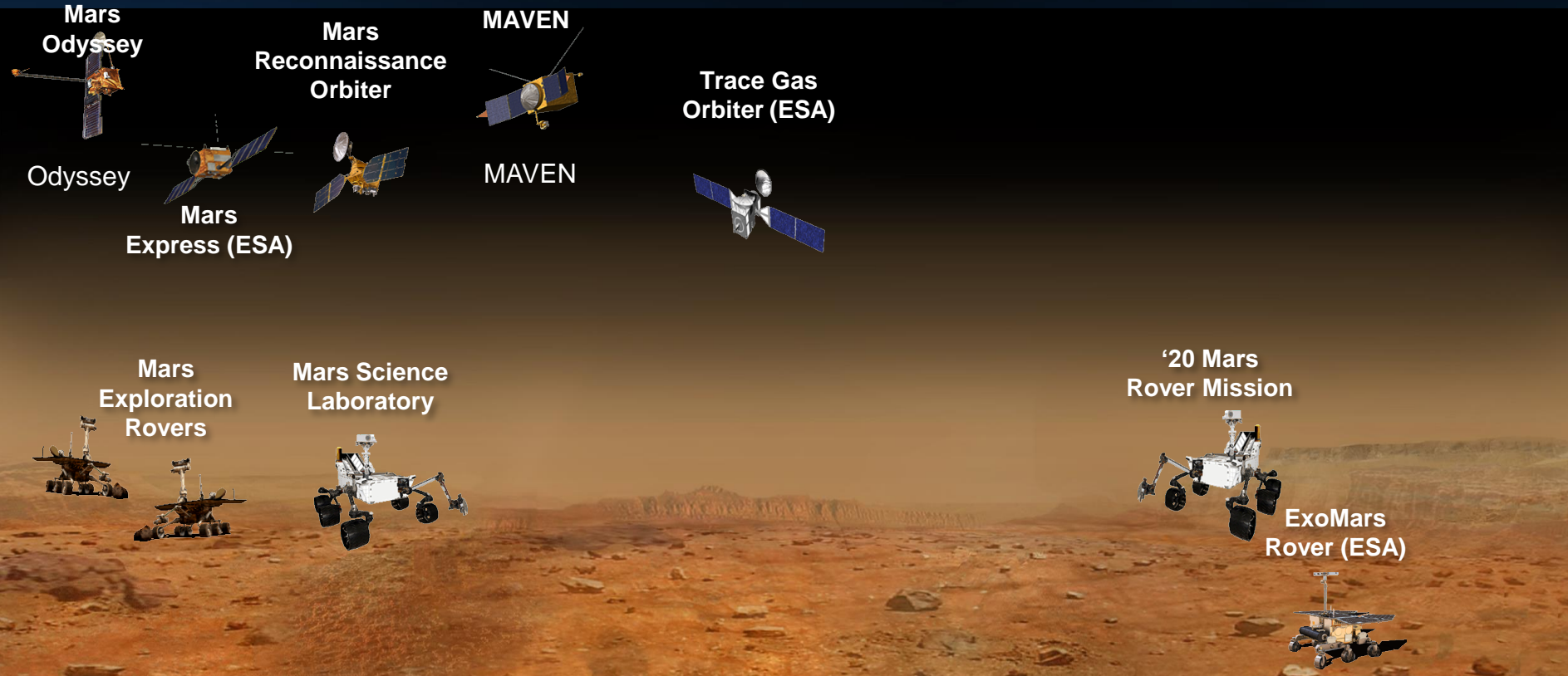
2001 - 2015

2016

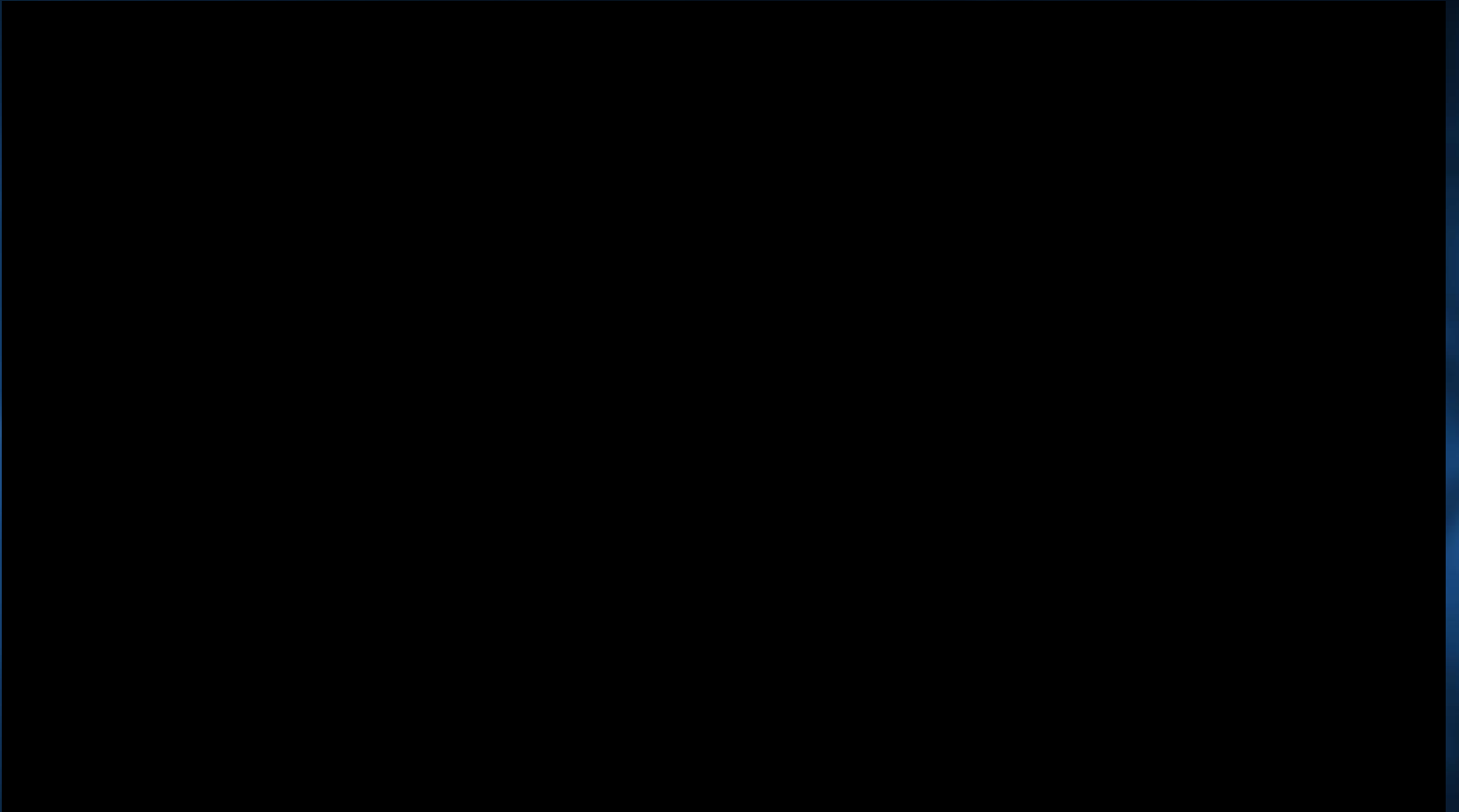
2018

2020

Future Mars
Missions



Curiosity Landing video

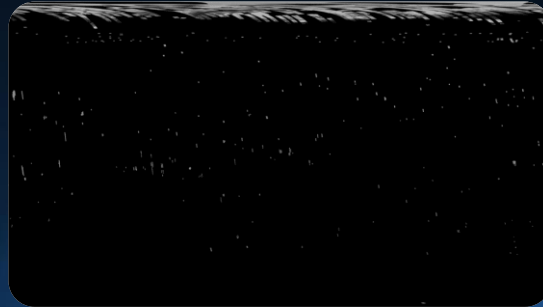


Mars Exploration Program Highlights

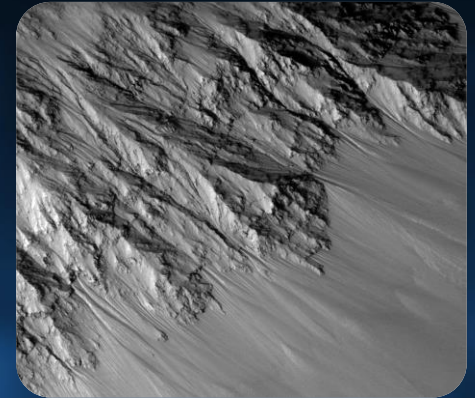
Opportunity: Journey to
Perseverance Valley



MRO: >50,000 orbits
Completed Global 6m
Resolution Imagery



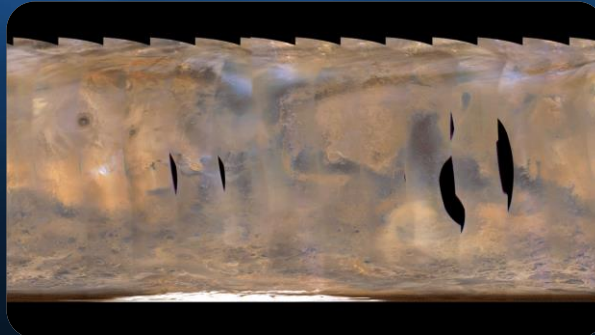
MRO: Continuing
Observations of Recurring
Slope Lineae



Curiosity: >5 years
since landing



MAVEN Tracks Back-to-back
Regional Storms



Mars 2020 Landing Site
Finalists



Mars 2020 Status

Mars 2020: Mission Overview



LAUNCH

- Atlas V 541 vehicle
- Launch Readiness Date: July 2020
- Launch window: July/August 2020

CRUISE/APPROACH

- ~7 month cruise
- Arrive Feb 2021

ENTRY, DESCENT & LANDING

- MSL EDL system (+ Range Trigger and Terrain Relative Navigation): guided entry and powered descent/Sky Crane
- 16 x 14 km landing ellipse (range trigger baselined)
- Access to landing sites $\pm 30^\circ$ latitude, ≤ -0.5 km elevation
- Curiosity-class Rover

SURFACE MISSION

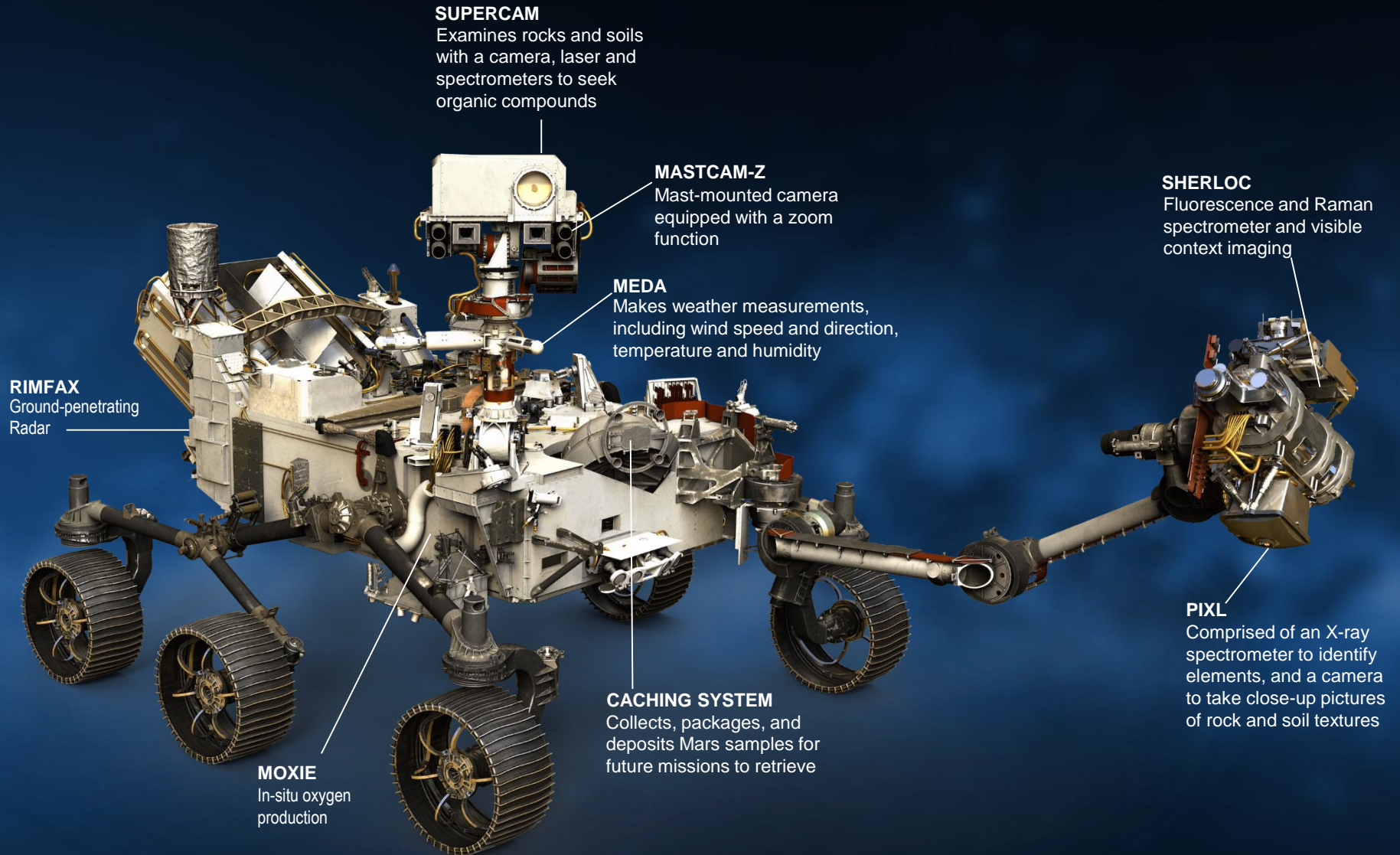
- 20 km traverse distance capability
- Enhanced surface productivity
- Qualified to 1.5 Martian year lifetime
- Seeking signs of past life
- Returnable cache of samples
- Prepare for human exploration of Mars

Mars 2020 Mission Objectives

- A. Characterize the... geologic record... of an astrobiologically-relevant ancient environment.
- B. Perform... astrobiologically-relevant investigations.
- C. Assemble rigorously documented and returnable cache...
- D. Contribute to the preparation for human exploration of Mars...

The Mars 2020 mission fully responds to the high priority Planetary Decadal Survey recommendation for a Mars science rover to perform in situ science and collect and cache a set of scientifically documented martian samples for potential future return to Earth

Mars 2020 Rover Instruments



Mars 2020 Candidate Landing Sites



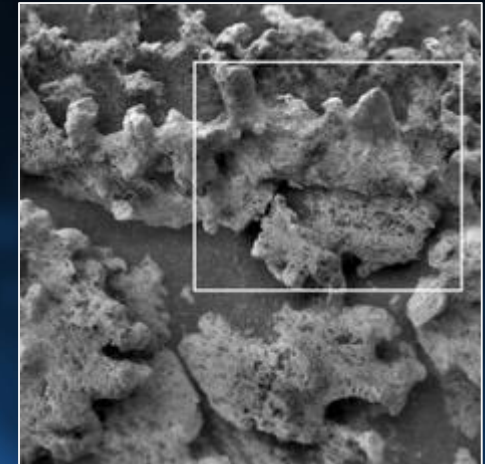
JEZERO

- Deltaic/lacustrine deposition with possible igneous unit and hydrous alteration
- Mineralogic diversity including clays and carbonates
- Shallow water carbonates?



NE SYRTIS

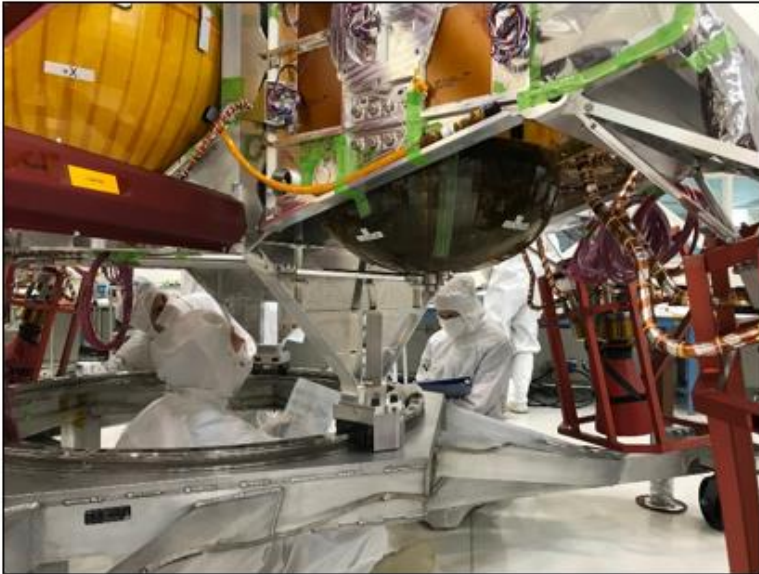
- Extremely ancient igneous, hydrothermal, and sedimentary environments
- High mineralogic diversity with phyllosilicates, sulfates, carbonates, olivine
- Possible serpentinization and subsurface habitability



COLUMBIA HILLS

- Carbonate, sulfate, and silica-rich outcrops of possible hydrothermal origin. Hesperian volcanics.
- Potential biosignatures identified
- Previously explored by MER

Descent Stage Walkdown 1/9/18



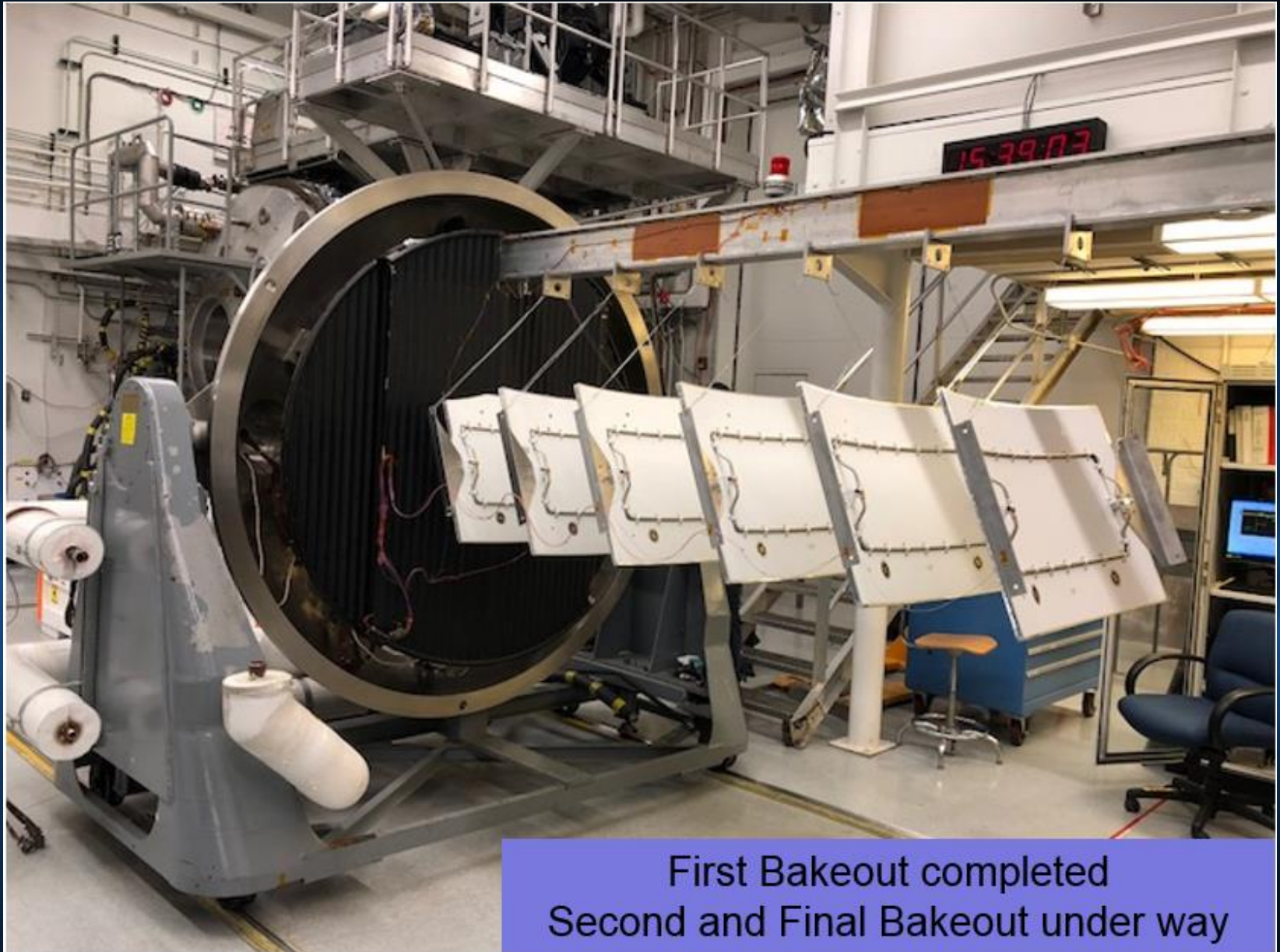
Propulsion is Done



TDS Fit Check
Successful!

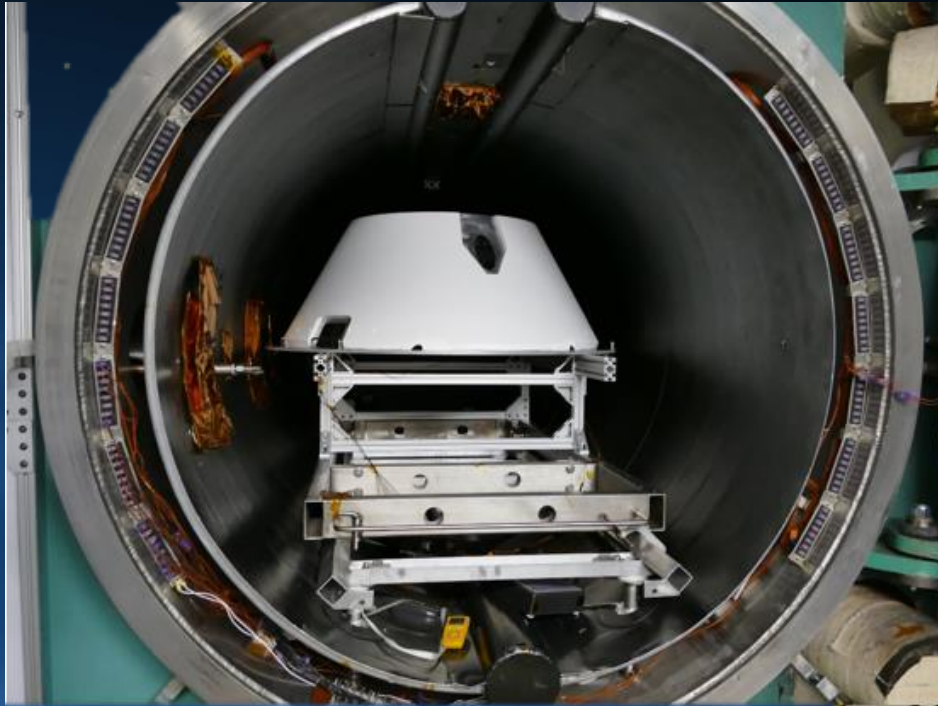


Cruise Stage Radiator Bakeout



First Bakeout completed
Second and Final Bakeout under way

PCC/CIP/Backshell Progress



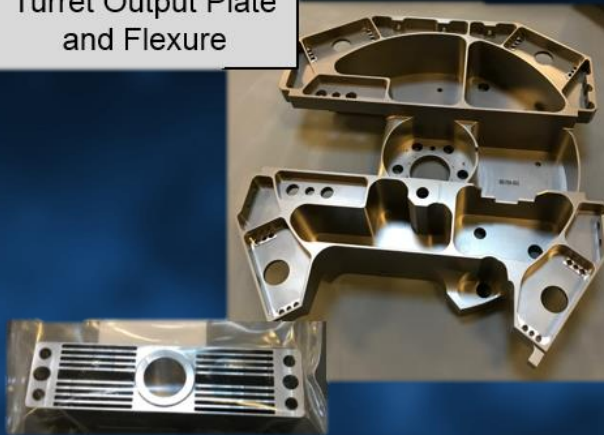
Robotic Arm Highlights

Piece Part Fabrication Continues

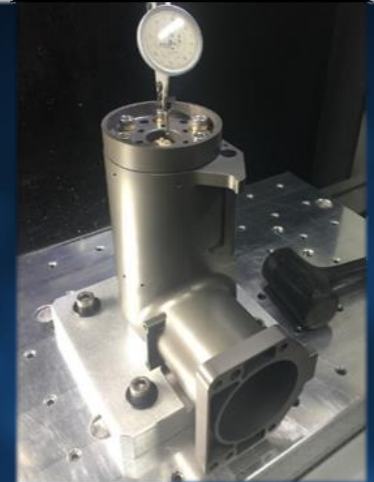
Upper Arm Fittings 80% complete



Turret Output Plate and Flexure



Wrist/turret fitting being match machined to facilitate wrist and turret actuator assembly



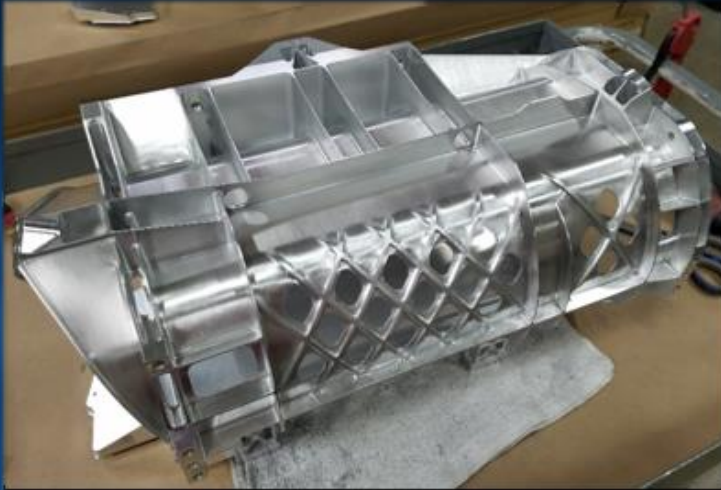
EM Shoulder Bracket 50% complete



Turret Output shaft caps arrived



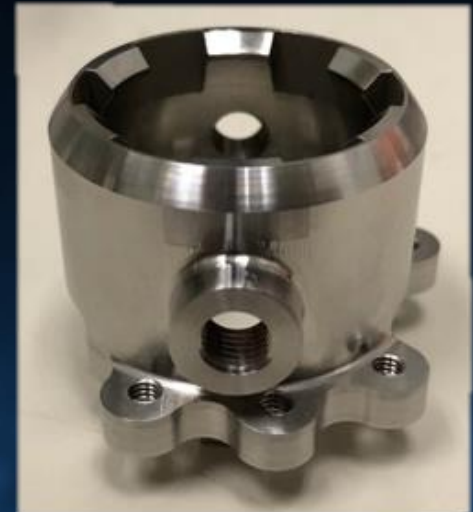
Turret / Corer Highlights



Feed Structure at SuperTech nearing final machining steps



Chuck Housing back from fab

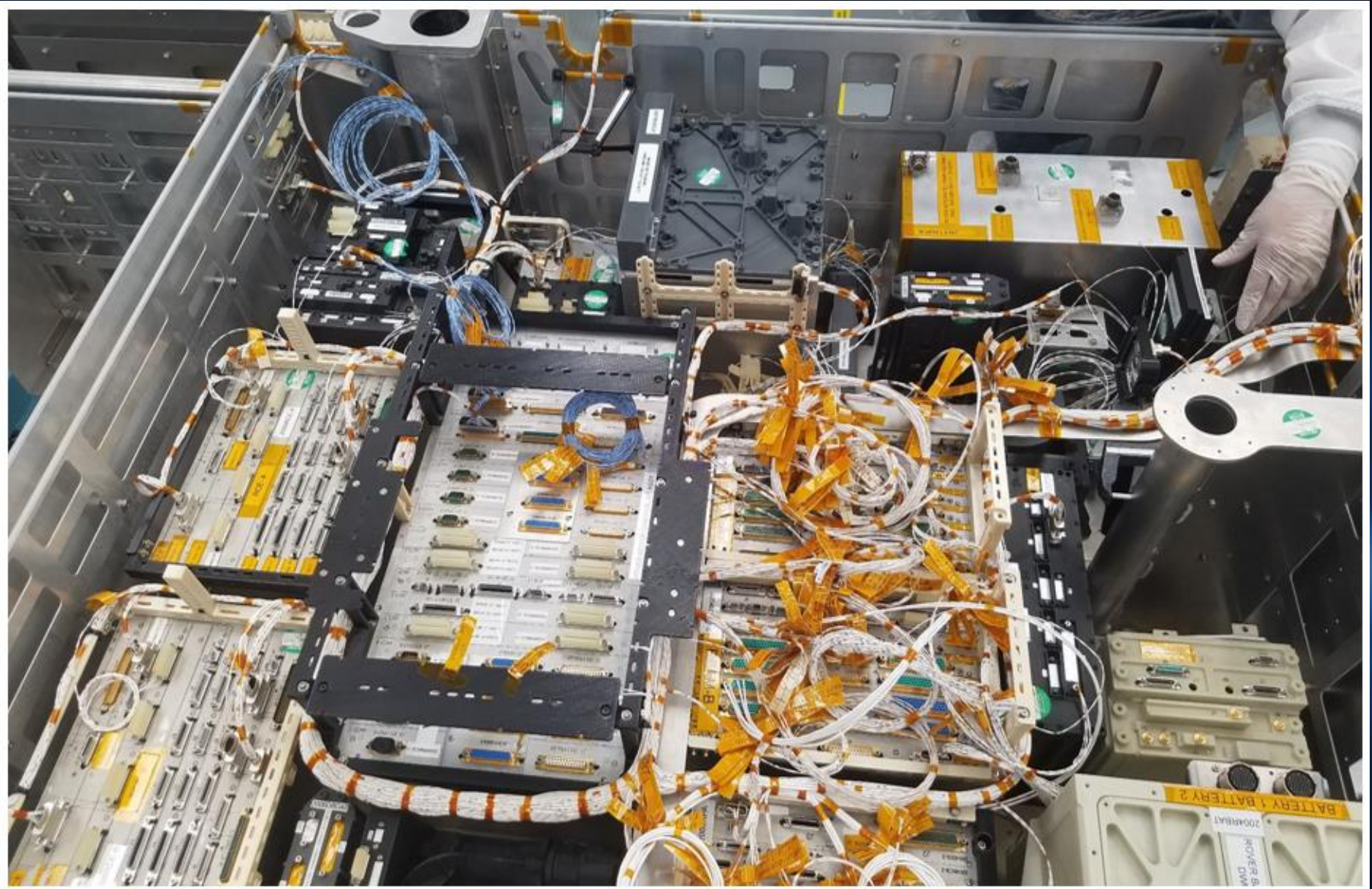


Feed Spherical Mount
in-house fab



Percussion Driver Plate
in-house fab

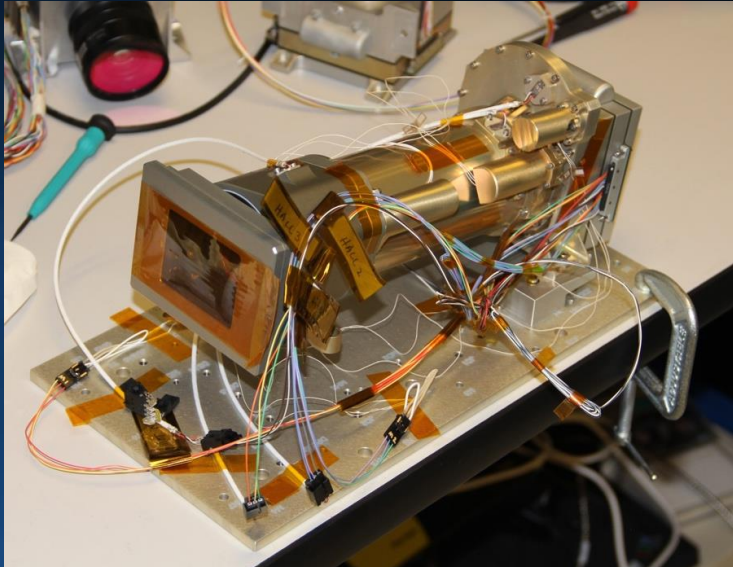
Rover Harness Production



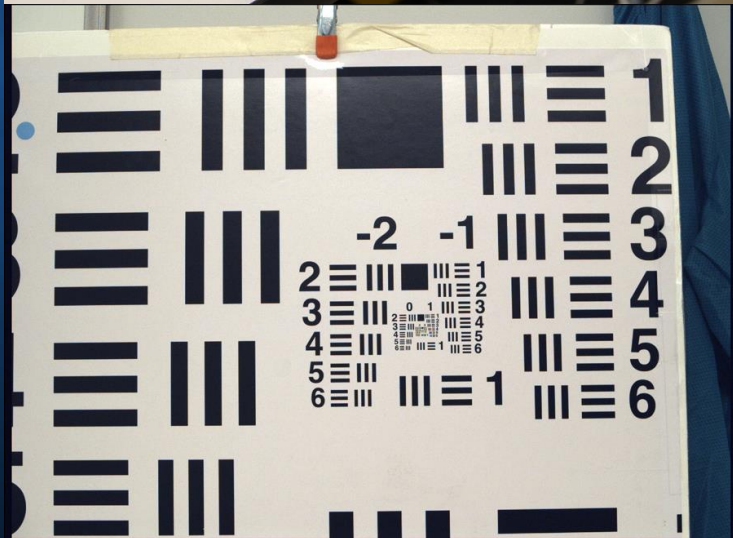
Payload Mastcam-Z Hardware

Assembled Mastcam-Z EQM at MSSS

Image date: 23 January, 2018



34 mm



100 mm

Why Mars Sample Return?

There are three primary reasons why MSR is of such high value to science.

1. Complex sample preparation, decisions
2. Better Instrumentation
3. Instrument Diversity

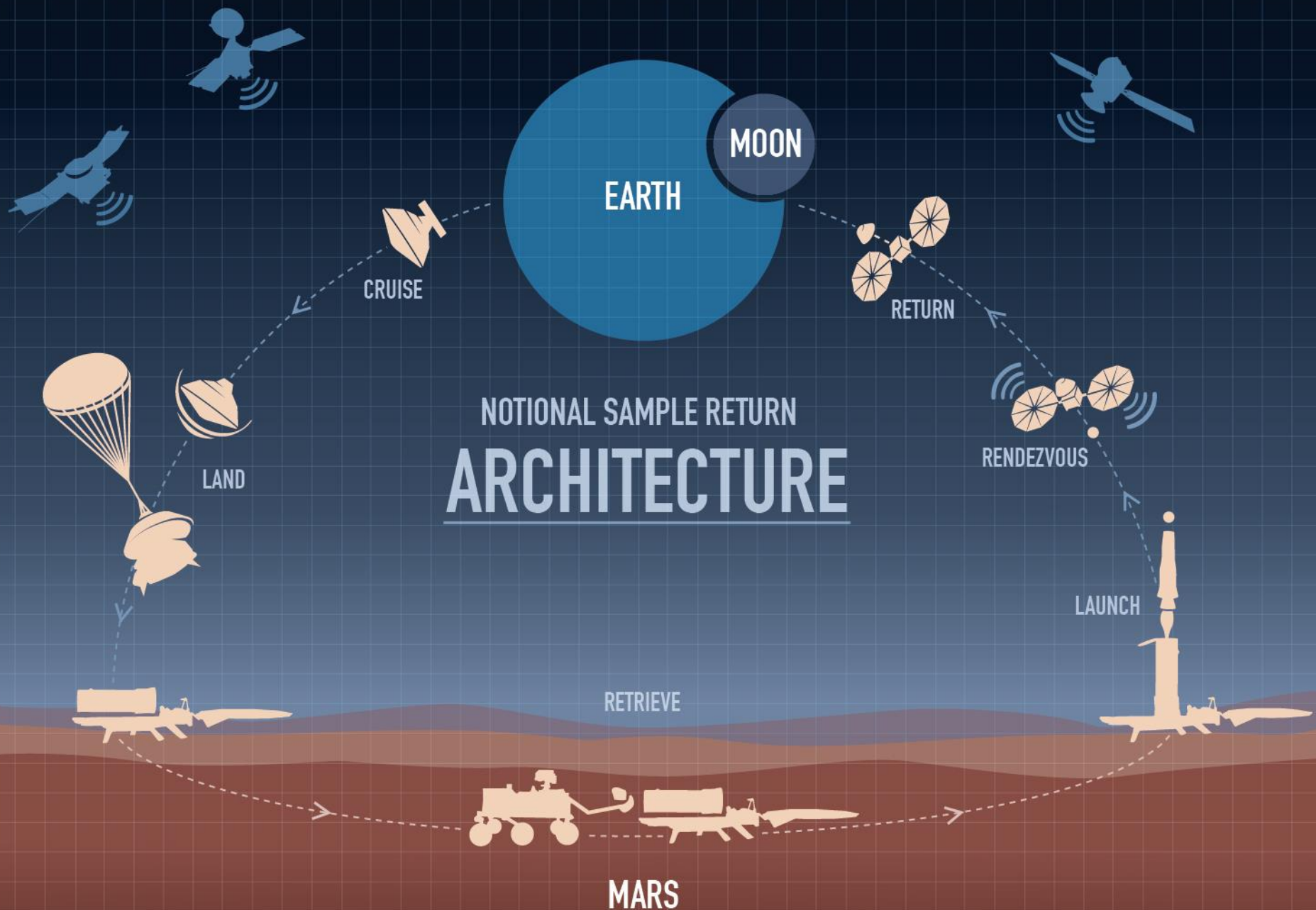


In-situ missions limited to a few sample analysis instruments.

A wide-angle photograph of a Martian landscape. The foreground shows dark, rocky terrain with some low-lying hills. In the middle ground, there are more prominent, layered rock formations and a large, light-colored, eroded hill. The background features a range of low, rolling mountains under a clear, pale blue sky. A dark blue horizontal bar is overlaid on the right side of the image, containing the title text.

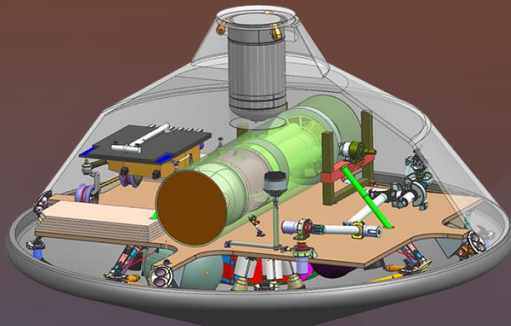
Mars Sample Return Planning

NOTIONAL SAMPLE RETURN ARCHITECTURE

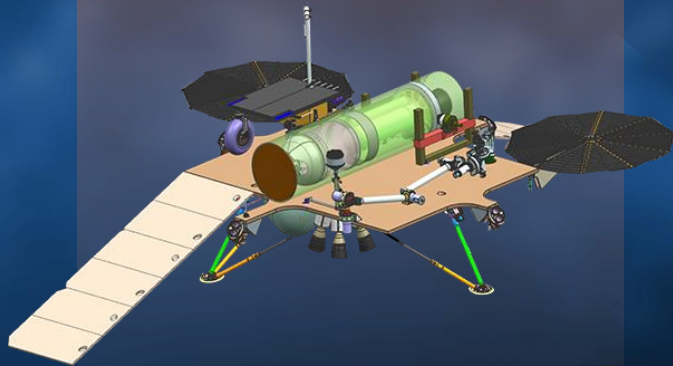


TWO LANDER CONCEPTS

2017 Highly Integrated Concept



*Propulsive Platform Lander (PPL) Concept
Packaged in MSL 4.5m Aeroshell*

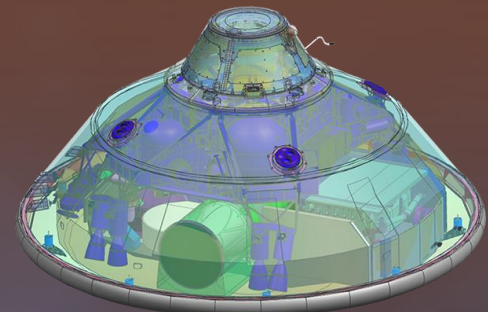


*Propulsive Platform Lander
Concept Deployed*

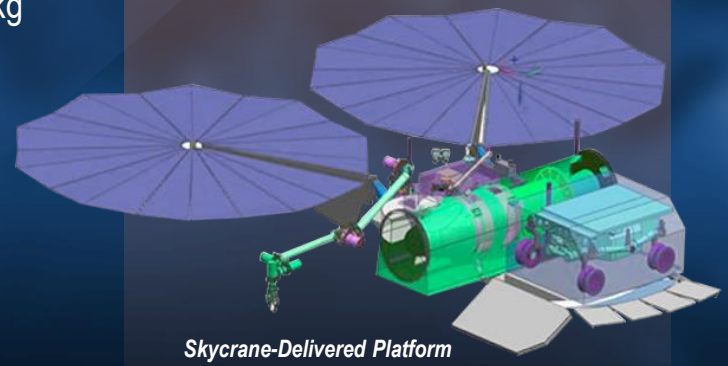
Common Attributes

- Identical cruise and entry architecture
- ~ 10 km landing ellipse
- ~ 900-1000 kg landed useful mass
- Accommodates ~ 600 kg MAV and Fetch Rover

Evolved 2011 Decadal Concept



*Skycrane-Delivered Platform Concept
Packaged in MSL 4.5m Aeroshell*



*Skycrane-Delivered Platform
Concept Deployed*

Two concepts that leverage Mars program legacy system capabilities

NOTIONAL SAMPLE RETURN ORBITER

Design for Orbital Rendezvous & Fast Sample Return

- Rendezvous & Capture
- Containment and Earth Planetary Protection
- Communication Relay Support for Surface Ops and Critical Events
- Return to Earth, either via
 - Direct return to Earth
 - Deliver to cis-lunar space for human-assisted returns

Implementation Options

- NASA provided
- Partner provided

